TJ Collamore

Mrs. Everett

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Imperfect Green Revolution Saves India

In the 1960s, India was on the brink of an era of mass starvation; it was the epicenter of a poorly fed yet exploding population where millions were predicted to starve (Lobb 155). To combat this problem, agricultural scientist M. S. Swaminathan urged his government to bring American experts to India to collaborate on new technologies that could radically increase food production. This dark period, in which there was too little food for too many people, was resolved by the Green Revolution. The Green Revolution was a time in which society used technological innovations to significantly increase the production of food grains through high-yielding crop varieties, the use of pesticides and fertilizers, and improved management techniques. The Green Revolution was a successful application of technology by the Indian government, as these innovations evoked an increase in food production, and thereby prevented the collapse of Indian society by both thwarting mass starvation and positively impacting the economy.

Technological innovation was the cornerstone of the Green Revolution and resulted in greater food production. Throughout the Green Revolution, India's farms employed new types of genetic engineering and irrigation technologies. Indians used these ideas to develop more unique types of crops. For example, the traditional varieties of wheat grew tall and slim, and fell over when mature. The main focus was to find a technology to restrict height, as taller plants were more difficult to harvest, and therefore decreased food production. The solution was the

modification of Mexican wheat varieties, which have a shorter stem than the original. This prevented the wheat from falling over under its own weight, making it easier to harvest (Thulasamma). The easier it is to harvest crops, the more that can be produced, sold, and consumed. The key to success for wheat was dwarf genes, as these genetic engineering technologies were used to boost food production, thus aiding society.

In addition to genetics, mechanization of irrigation operations improved. Two examples of this are the introduction of diesel engines and electric pumps to farms. In the early 1950s, 17 percent of the area was cultivated and used for irrigation, but by the 1960s it increased to 20 percent (Thulasamma). This significant increase in irrigation enabled greater water flow between crops and across farms. Water is not only essential to the nourishment of crops, but also amplifies their resistance to drought. The irrigation projects created during the Green Revolution allowed water to be more accessible, thus also increasing food production.

Regarding heightened food production, wheat production in India almost doubled from 1965 to 1975. It continued to increase, as by 1995, the production of wheat became 2.6 times more than 1965 (Leaf 452). In rice paddy production, India produced 30.6 million metric tons of rice in 1965 to 1966. Then, from 1976 to 1977, India produced a total of 52.7 million metric tons of rice (Leaf 453). These significant increases in food production are evidence of the success of the Green Revolution's technological innovations, and overall contributed to the creation of a more enhanced and successful Indian society.

An increase in food production provided the foundation of a more successful Indian society, largely due to its thwarting of mass starvation. By 1960, India was on the brink of a mass starvation event due to the combination of population growth and insufficient food sources. There were too many people and not enough available resources. There were on average 22.5

deaths per thousand people, and the life expectancy rate was only 41 years (World Bank). Many scientists and observers thought this widespread famine would be unavoidable. Millions of people were being born, and it was at the point that there were more people than accessible food (Lobb 155).

At this time, well-known Western authors were even arguing that "the limited food surpluses of the West should be conserved for countries capable of being saved [and that] countries incapable of being saved, like India, should be left to starve, for the greater good of humanity" ("Drought Not a Big Calamity"). This emphasizes the magnitude of India's risk of starvation and its global recognition. "The Green Revolution averted that threat" (Leaf 453) and improved the overall society of India, because as previously emphasized, it engendered a significant increase in food production, and the more food that is available, the fewer people that will starve. By the turn of the century, 81.6% of the population was meeting or exceeding the minimum level of dietary energy consumption (World Bank). With extended food availability, a greater percent of the population was able to achieve its dietary needs. Failure to meet dietary needs otherwise results in sickness and death. By 1980, the number of deaths per thousand people had almost dropped in half, and life expectancy increased from 41 to 53 years. This decrease in death and increase in life expectancy as a result of Indian civilians' ability to meet their dietary energy consumption proves that the Green Revolution (and its corresponding increase in food production) prevented mass starvation and hence successfully avoided the collapse of Indian society.

The Green Revolution also proved successful through the positive changes in India's economy that resulted from the movement's expansion of food production. The improvement of India's economy can be measured by an increase in income levels, exports, and national Growth

Domestic Product (GDP). With respect to income, prior to the Green Revolution, India was one of the poorest countries in the world; in 1966, the per capita income was only $90 (World Bank). India held millions of homeless refugees who lived in severe poverty (Sanyal 207). By increasing food production, however, the Green Revolution specifically increased the overall income of a large number of the peasants and wage laborers working in the food industry, both with larger companies and on smaller residential farms (Mishra 289). By 1980, the per capita income ballooned to $267 (World Bank), a threefold increase, proving the large-scale positive impact of the Green Revolution on India's economy.

Not only did the increased production of food grains during the Green Revolution improve the per capita income, it also aided the economy by facilitating greater exports. In 1970, India had $2.36 billion in exports; by 1980 this figure had more than quadrupled to $11.44 billion (World Bank). Agricultural products were a primary contributor to these exports, as India started this mass expansion by exporting the wheat and paddies of rice which composed the revolution's amplified food production. The extent of this expansion is highlighted by comparing India's trade status in the 1960s to modern times. Back in the 1960s, India couldn't afford to import food, and depended on charity; by 2012 government food stocks exceeded 80 million tons ("Drought Not a Big Calamity"). In consequence of the Green Revolution and increased food production, India evolved from struggling to acquire food to producing it for both itself and other nations. India has become a valuable resource for other countries around the globe, as it "not only fed its burgeoning population but has emerged as a net exporter and first responder to the needy across the world" ("The Time"). The fact that India was able to grow from existing in a state of starvation and poverty to one in which it prevents malnutrition in other nations is a clear

representation of its economic successes and the positive effects of the Green Revolution's augmented grain yield.

Another critical determinant of India's economic success after the Green Revolution is its increased overall GDP. In 1966, the GDP in India was $45 billion and by the end of the Green Revolution in 1980, it had swelled to $186 billion (World Bank). Although agriculture's direct contribution to GDP decreased from 52% of GDP in 1950 to only 29.5% in 1990 ("Drought Not a Big Calamity"), avoiding the mass starvation event enabled the population to contribute to the economy in other areas. In fact, in India "a 1% rise in agricultural output raises industrial production by 0.5% and national income by 0.7%, according to one calculation" ("25 Years"). Hence, the fact that agriculture's contribution to GDP lessened over time does not oppose the success of the Green Revolution, but rather showcases the ways in which the nation's overall wealth is intensely connected to its farmers. The Green Revolution enabled farmers' success, and thereby led to the economic growth of India as a whole.

While the Green Revolution was successfully initiated by Indian society, some individuals pose criticism upon it. Detractors argue that the implementation of the Green Revolution, specifically the introduction of technological innovation, was a form of imperialism. However, the Green Revolution was not a form of imperialism; it was initiated in India by India. Chidambaram Subramian was an Indian politician and government official in the 1960s who helped create a major increase in wheat production throughout the nation. When Subramaniam was minister for food and agriculture, he persuaded Indian governments to spread new wheat varieties to more than a million Indian farmers (Dugger). Subraminan was an example of a person who pushed from within his own country to save his fellow citizens from starvation, and make his country less dependent on the charity of other countries. This disproves a common

argument that the Green Revolution was in essence imperialism, as this endeavor was the will of the local government and led to greater independence.

An additional critique of the Green Revolution is that its advancements to farming had negative implications on the environment, specifically with respect to pesticides. Although agricultural science techniques like pesticides had potentially harmful effects to human consumers and the environment (Schafer 108), it was necessary for people to use new techniques in order to save humanity. As people learned the downsides of pesticides and chemicals, techniques could later be improved so that the environment can benefit. The pesticides helped solve the food crisis of the era, thus saving lives and positively affecting society. Despite excessive use of pesticides and chemicals, radically more efficient techniques yielded significant preservation of other land that otherwise would need to be dedicated to farming. There was improved productivity for the land and boosted agricultural production, and it was estimated that the land's crop rate tripled after the heightened land productivity (Lobb 156). In India, the wheat fields "increased from 9,132 kilograms per hectare in 1965 to 12,384 kilograms per hectare in 1975 and to 14,356 kilograms per hectare in 1980. By 1995, the yield in India was 25,590 kilograms per hectare" (Leaf 452). Without the Green Revolution half of the world's remaining forest-land would have to be cleared for agricultural use in order to feed starving people (Lobb 156). During the Green Revolution, millions of acres of land were farmed more efficiently (Lobb 156). This allowed farms to improve their production of crops and livestock, overall improving the economy. While there were negative effects of the Green Revolution, this was needed to allow society to continue to improve upon later.

Although imperfect, the Green Revolution was India's successful means of enhancing food production and respectively both preventing a mass starvation event and advancing the

economy. Food development was enacted through technological innovations such as genetic engineering and irrigation. These improvements decreased starvation levels, and increased life expectancy, per capita income, exports, and national GDP; the Green Revolution saved countless lives in India and increased their standard of living. Interestingly, in 2010, another food shortage appeared in India ("Indian President"). If the original Green Revolution had a negative impact for India, later Indian leaders wouldn't advocate for a second one, proving the success of the first. The Green Revolution was a complex and daring application of technology in India to save millions of citizens from starvation.